Difference Between Reducing Sugar and Starch

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Key Difference - Reducing Sugar vs Starch

Redox is a chemical reaction which changes the oxidation number of a molecule, atom or ion. Oxidation and Reduction are the main two events occur during the Redox reaction. Loss of electrons or increase in oxidation state is known as oxidation while the gain of electrons or decrease in oxidation state is known as reduction. Reducing agent is a molecule which can donate an electron to another molecule and become decreased in oxidation state. Some sugars can act as reducing agents. They are known as reducing sugars. Reducing sugars have the aldehyde group to become oxidized and convert into the carboxylic acid group. Starch is a polymer made of amylose and amylopectin. It is the major carbohydrate reserve in plants. Starch does not possess a free hydrogen molecule which is attached to oxygen. Hence, starch is unable to be formed the open aldehyde and as a result unable to be oxidized and reduced other sugars. The **key difference** between Reducing sugar and Starch is that **starch is not a reducing sugar due to the absence of hydrogen on the circled oxygen to allow for ring opening**.

What is Reducing Sugar?

Sweet soluble carbohydrates are known as sugars. There are various types of sugars. They can be monosaccharides (simple sugars), disaccharides or polysaccharides. Monosaccharides include glucose, fructose, galactose etc. Disaccharides include sucrose, lactose etc. Polysaccharides include starch, cellulose, pectin etc. Most of the monosaccharides are having an aldehyde group or a ketone group. Hence, they can be oxidized and act as a reducing agent for another molecule. Any sugar which is capable of acting as a reducing agent is known as a reducing sugar. Sugar molecule becomes oxidized by reducing another compound. During this reaction, the carbonyl carbon of the sugar molecule converts into a carboxyl group losing electrons.

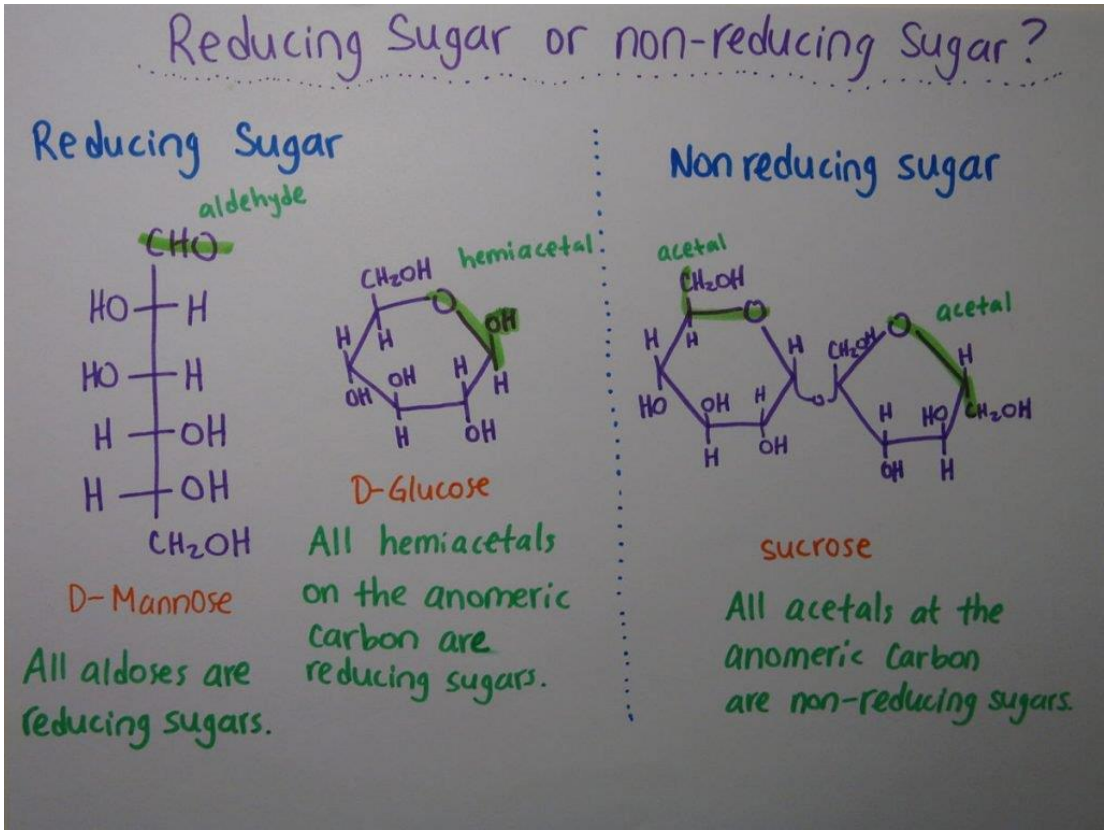

Figure 01: Reducing Sugar

The sugar that we consume is sucrose. Sucrose is a disaccharide made from one molecule of fructose and one molecule of glucose. Sucrose does not have a free aldehyde or keto group. Therefore it is a non-reducing sugar. Some disaccharides are reducing sugars such as lactose, cellobiose, and maltose. Some oligosaccharides and polysaccharides are also acting as reducing agents. Reducing sugars can be identified by a simple test which is known as Tollens' test or Benedict's test.

What is Starch?

Starch is a highly branched and highly organized polymeric carbohydrate. It is a white, tasteless granular organic compound made from amylase (linear polymer) and amylopectin (branched polymer). Starch is a polysaccharide which has the chemical formula of $(C_6H_{10}O_5)n$. Starch is produced by green plants as an energy reserve in seeds, roots, tubers, stem and in fruits. Since most of the plant matter contains starch, it is the most common carbohydrate in the human diet. Starch is the main polymer in most of the foods that we eat such as wheat, rice, potatoes, maize etc.

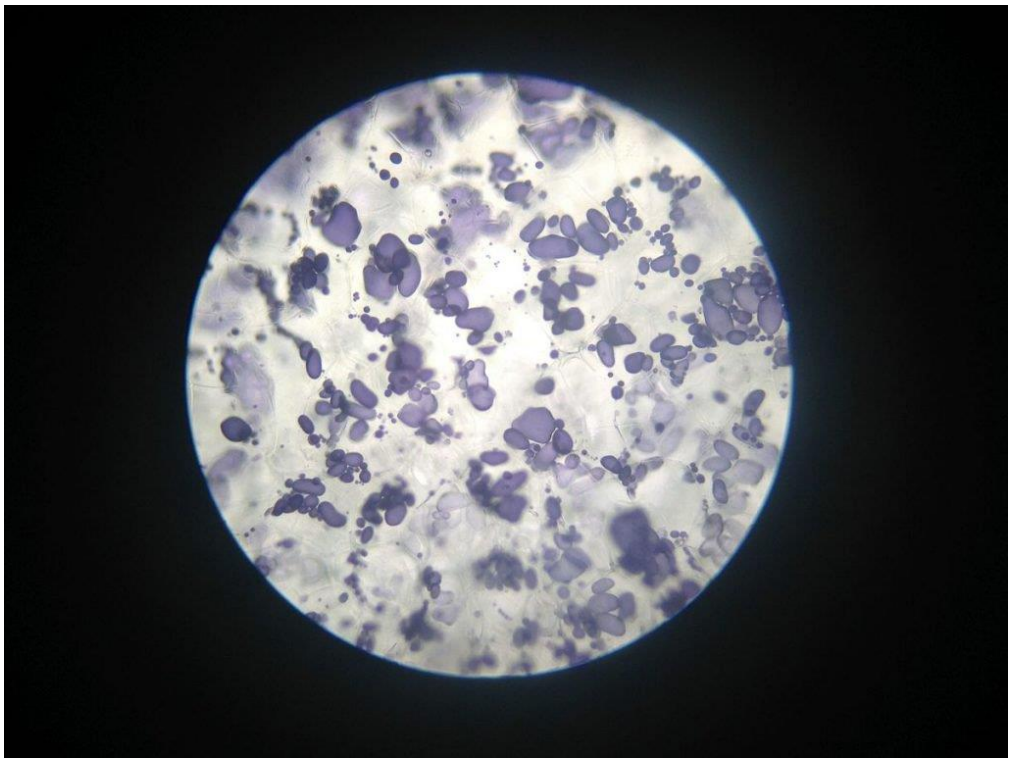

Figure 02: Starch

Starch is a non-reducing sugar. It does not have a free aldehyde or ketone group to open up the starch structure. Starch can be identified by Iodine test. Starch gives a Blue-Black color with iodine. Glycogen which is in animal tissues has a similar structure to starch. But glycogen is highly branched than starch.

What are the Similarities Between Reducing Sugar and Starch?

- Reducing sugars and starch are carbohydrates
- Both are made from monosaccharides.
- Both contain C, H, and O.
- Reducing sugars and starch are found in plants and other organisms.

What is the Difference Between Reducing Sugar and Starch?

Reducing Sugar vs Starch	
Any sugar which is capable of acting as a reducing agent is known as a reducing sugar.	Starch is a complex polymer made from amylase and amylopectin and is a non-reducing sugar.
Type of the Sugar	

Most of the reducing sugars are monosaccharides.	Starch is a polysaccharide.
Presence of Free Aldehyde or Keto Group	
Reducing sugar has a free aldehyde or keto group.	Starch does not have a free aldehyde or keto group.
Benedict Reaction	
Reducing sugar gives dark red color (brick color).	Starch does not give red color, instead remains as green in color.
Iodine Reaction	
Reducing sugar does not give blue/black color.	Starch gives blue/black color.

Summary – Reducing Sugar vs Starch

Carbohydrates are different types such as monosaccharides, disaccharides, oligosaccharides, and polysaccharides. Starch is a polysaccharide composed of linear polymer amylase and branched polymer amylopectin. It is a highly organized complex polymer which does not have free aldehyde or ketone group. Sweet carbohydrates are mostly referred as sugars. Some sugars mainly monosaccharides and some disaccharides act as reducing agents since they possess free aldehyde or ketone groups in their structures. Hence they are known as reducing sugars. Starch is not a reducing sugar. However starch is the main organic compound which is produced by plants to store energy. This is the difference between reducing sugar and starch.

Reference:

1.“Starch.” Encyclopedia of Food and Culture, Encyclopedia.com. Available here
2.“Reducing sugar.” Wikipedia, Wikimedia Foundation, 2 Dec. 2017. Available here

Image Courtesy:

How to Cite this Article?

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